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(54) Title: METHOD AND MATERIALS GIVING TERMITE PROTECTION TO BUILDINGS

(54) Titre: PROCEDE ET MATERIAUX POUR LA PROTECTION ANTI-TERMITE DES CONSTRUCTIONS

(57) Abstract

The invention concerns the application of a plastic film impregnated with an anti-termite agent around the sides and base of an excavation site. Said plastic film is combined with anti-termite granules in backfill in the region of pipe and duct passages. This film has a preventive function and does not require repeat treatments. It can be further used in the form of curative or preventative renewed treatment in old constructions.

(57) Abrégé

L'invention concerne l'application d'un film plastique imprégné de termicide sur tout le pourtour et le fond des excavations. Combinaison avec des granulés termicides en remblai aux passages de gaines et canalisation. Applications préventives ne nécessitant pas de traitements de renouvellement. Egalement application en curatif ou préventif de renouvellement sur construction ancienne.

PROCÉDÉ ET MATÉRIAUX POUR LA PROTECTION ANTI-TERMITE DES CONSTRUCTIONS

La présente invention est relative à la protection préventive anti-termite des constructions.

A l'heure actuelle, la protection des constructions à l'encontre de la pénétration des isoptères (termites) nuisibles est généralement opérée par épandage, pulvérisation ou injection de produits insecticides à des doses qui doivent se révéler suffisantes pour assurer une protection de plusieurs années. L'interdiction d'utilisation de certains insecticides efficaces mais présentant des nuisances toxiques et écotoxiques accentuées a amené à avoir recours à des substances moins dangereuses, mais moins stables chimiquement, de sorte qu'il y a lieu de renouveler les opérations à des intervalles de temps plus réduits, ce qui pose des problèmes délicats par suite de la dissémination, dans l'environnement, de matières indésirables.

De plus, ces traitements de renouvellement préventifs et curatifs sont effectués par définition après la construction du bâtiment, et il faut donc percer les murs, dalles etc..., ce qui se traduit par des travaux lourds, coûteux, provoquant des désagréments et dont l'efficacité totale est difficile à assurer, car on ne peut pas toujours percer le nombre recommandé de trous. Par ailleurs, après la construction, certains endroits peuvent se révéler être inaccessibles à de tels traitements curatifs et/ou préventifs.

Enfin, la tentation peut être grande, pour tenter d'augmenter l'efficacité des traitements curatifs et/ou

2. Utilisation de substances de nouvelle génération.

3. Traitement « total » (« barrière chimique ». continue donc pas de passages non protégés)

4. Traitement « définitif » (pas de nécessité d'avoir recours à des retraitements préventifs ou à des traitements curatifs en cas d'échec).

On connaît aussi divers matériaux plastiques à libération contrôlée de manière active. On connaît, notamment par le document FR-A-2 491 037 (ROUSSEL-UCLAF), des matériaux d'emballage et de revêtement à propriétés insecticides constitués par un film de matière plastique (polyéthylène par exemple) qui est imprégné dans la masse à l'aide d'un composé de type pyréthrinoïde.

On connaît le document JP 59-62503 qui décrit un papier kraft imprégné de termicide et recouvert sur ses deux faces d'un film plastique. Le produit est supposé diffuser au travers du polyéthylène. Il s'agit d'un produit composite résistant et destiné à un usage « sous plancher » c'est-à-dire dans des zones précises. Il s'agit par ailleurs d'une technologie ancienne (1982) c'est-à-dire une date où des termicides puissants étaient autorisés, ainsi que des doses élevées, ces paramètres étant aujourd'hui sévèrement réglementés.

On connaît également le USP 5,224,288 qui, lui, présente le grand intérêt d'illustrer l'état de la technique à la veille (1993) de la présente invention. Ce brevet américain décrit un tapis fibreux imprégné de termicide. Les fibres sont impératives car seule cette structure assure à la fois une grande surface spécifique et une résistance mécanique suffisante. Par ailleurs, ce document précise que, impérativement, la dimension de maille de la structure fibreuse doit être plus petite

dérouté et refait. Quand bien même subsisterait un défaut non localisé, il en résulterait un dommage faible.

Au contraire, dans le secteur des travaux publics, il était invraisemblable de demander aux ouvriers du chantier de poser avec grand soin un film mince sur le sol et autour des fondations, de vérifier avec le plus grand soin qu'aucun fer à béton, caillou, débris etc... ne viendra perforer le film (nous rappellerons que les colonies de termites sont en perpétuelle expansion et que leur instinct les pousse à rayonner autour de la termitière – le sol humide et « calme » sous une construction leur convient particulièrement bien – et à se propager le long, préférentiellement, des canalisations etc... et que par conséquent un seul passage non protégé suffit pour une invasion par les termites), de disposer avec soin et précaution les remblais, matériaux de construction, ciment, etc... pour que ces matériaux ne viennent pas à leur tour perforer le film, c'est-à-dire de demander à des ouvriers de chantier de renoncer à leurs pratiques, par ailleurs liées à leur secteur technique et donc compréhensibles.

Cela était d'autant plus invraisemblable que des passages doivent être ménagés, dans les fondations notamment, pour le cheminement des canalisations, câbles etc... de toutes sortes, ce qui oblige à perforer, inciser, etc..., le film.

Enfin, un film à libération progressive de produit termicide, par définition, ne pouvait que libérer des doses faibles de produit par unité de temps comme confirmé par USP'288 précité ; on pouvait donc au mieux espérer un effet plus ou moins répulsif aux endroits où le film ne serait ni déchiré, perforé ou mal posé, ou ouvert aux canalisations, etc..., effet qui allait donc conduire tout simplement les insectes vers les endroits

La Figure 3 représente un agrandissement de la Zone A de la Figure 2 ainsi que les moyens détaillés de l'invention et leurs effets.

Sur la figure 1 on peut voir que dans l'excavation obtenue après les travaux de terrassement destinés à l'édification des fondations (en tracé interrompu) de la construction, on a étendu une série de lés 1 d'un film en une matière plastique imprégnée d'un produit insecticide. Ces lés 1 se chevauchent les uns les autres (2) et ils recouvrent toute la surface constructible, en débordant même largement au niveau du sol (3).

La Figure 2 montre ce que l'on rencontre dans la pratique. Certains lés (9) sont mal posés en recouvrement (pas, ou pas assez, de chevauchement). Des cailloux ou gravats (4) perforent le film. Lors de la mise en place des grillages et fers à béton (6), des protubérances perforent le film. Lors de la coulée des fondations, le film va s'écarter ou s'allonger sous la pression de la coulée m, et un risque de poinçonnement va apparaître aux endroits où existe une arête coupante sous le film (4) ou aux endroits, nombreux, où un vide subsiste sous le film (car il est évident que le fil m n'épouse pas étroitement un sol bien préparé ; il ne peut être que seulement posé sur un sol inégal encombré de gravats, et accidentellement de pièces métalliques etc...) comme illustré en (8). De toutes façons, le film doit être volontairement perforé pour laisser passer des canalisations ou gaines (7).

Chacun de ces incidents crée une fente, ouverture, déchirure (5) dont beaucoup sont imprévisibles et ne peuvent même pas être connues, et une seule de ces fentes, ouvertures, déchirures suffit pour permettre l'invasion par les termites.

Ainsi, le problème posé est d'atteindre le « zéro défaut », ici le « zéro point de passage ». La Figure 2

perturbé après seulement 10 s d'exposition : difficulté à se mouvoir, troubles de l'orientation et perturbations analogues. Ceci est totalement contraire à l'enseignement du USP'288.

L'insecte atteint ainsi sans pouvoir s'enfuir, le laps de temps également très court au terme duquel se manifeste l'effet de choc léthal.

Ainsi, dans le cas extrêmement général où l'insecte se présente face à un film sain, il est soit repoussé, soit soumis à l'effet de contact puis à l'effet de choc. Dans le premier cas, il peut chercher une ouverture moins protégée et la trouver. Mais même dans ce cas, la demanderesse a établi que contrairement aux prévisions et connaissances, l'insecte était alors soumis très rapidement (quelques secondes seulement !) à l'effet de contact qui l'amenait à l'effet de choc.

Ainsi, la demanderesse a établi que même selon une pratique de pose assez peu soignée, un film termicide conférait une protection totale et définitive, grâce à une double barrière schématisée sur la Figure 3, de répulsion (protection des ouvertures) et effet de contact et de choc (destruction).

Le film de matière plastique qui forme les lés 1 peut être obtenu par extrusion de polymères, notamment de polyoléfines comme le polyéthylène ou le polypropylène ou le polychlorure de vinyle et (co)polymères analogues, l'épaisseur étant comprise entre 50 μm et 300 μm. L'insecticide est intégré à la matière plastique lors de la fabrication du compound, le taux étant fonction de l'efficacité de la matière active utilisée. La fabrication du film se fait à partir de ce compound, par extrusion-soufflage à chaud ou par extrusion, l'une et l'autre extrusions pouvant être éventuellement suivies d'un calandrage à chaud et procédés analogues connus de l'homme de métier.

mélange sur une épaisseur et une profondeur d'environ 10 cm au moins.

Les granulés utilisés ont préférablement (ceci dépend de la nature du terrain, du degré de lavage par les eaux, et de l'appréciation de la dose libérée, facteurs que l'homme de métier pourra facilement déterminer par des essais de routine à la lecture des exemples et tableaux ci-après) des dimensions de l'ordre de environ 2 à 3 mm de diamètre sur une longueur de environ 2-5 mm. Leur composition chimique est similaire à celle du film qui constitue les lés 1. Il peut s'agir aussi de déchets de fabrication du film ou de rebuts de film, etc..., et analogues mais ceci n'est pas préféré (problèmes d'homogénéité des doses libérées). Par précaution, on pourra procéder de même aux endroits où le film est le plus exposé à une déchirure probable, comme en (8). On préfèrera des granulés et toutes géométries comportant des aspérités ou arêtes vives, comme par exemple des joncs tronçonnés.

Le grand avantage de cette variante est double : mise en œuvre facile par les ouvriers du chantier, aucun soin particulier n'étant exigé ; et utilisation préférée des déchets etc... du film.

Après ces opérations *simples*, les travaux de maçonnerie peuvent être repris.

Les avantages secondaires obtenus par ce procédé de protection anti-termite par rapport aux systèmes classiques d'épandage de composés insecticides en phase liquide se révèlent également indiscutables.

- Les matières actives insecticides sont protégées des agressions extérieures par la matière plastique du film auquel elles sont intégrées, ledit film autorisant une lente diffusion.

- Les quantités de produits insecticides sont très nettement inférieures à celles mises en œuvre selon le

qui n'est donc pas en contact avec le film traité sert, après réhumidification quotidienne, de nourriture et de réserve d'eau aux insectes nécessaires à l'expérimentation. Après introduction dans chacun des dispositifs de 25 ouvriers Réticulitermes santonensis en bon état sanitaire, un couvercle en mousse de polyuréthanne vient coiffer chacun des montages. Le taux de mortalité est vérifié à 6 heures, 12 heures, 24 heures, puis chaque jour durant 7 jours, à compter de la date d'introduction des insectes dans les dispositifs expérimentaux. Pour chaque concentration de biocide dans la matière plastique, ont été effectuées deux répétitions de l'essai qui, lui-même, met en œuvre quatre dispositifs expérimentaux de 25 termites par concentration.

Le tableau suivant résume les résultats expérimentaux obtenus.

Dose de biocide en % (m/m) dans le support	% de mortalité						
	6 H	12 H	24 H	2 J	3 J	4 J	7 J
0,005	0	0	0	4	12	20	65
0,05	50	64	100				
0,25	100						
0,50	100						
1,00	100						
Témoins	0	0	0	0	0	2	8

CONCLUSIONS :

A la dose de 1 % de benfuracarbe incorporée au polyéthylène, le matériau présente des caractéristiques anti-termites satisfaisantes.

b) - Étude de l'influence du délavage par les eaux d'infiltrations sur l'activité insecticide du matériau plastique mise en œuvre par le procédé sujet de l'invention

Des échantillons de films traités comme décrits précédemment sont emprisonnés dans de la mousse polyuréthanne. Ils sont introduits verticalement dans des tubes en verre de diamètre 50 mm, et de hauteur 50 mm, à raison de 4 échantillons par tube, traités aux mêmes doses et avec le même principe actif. Un dispositif distributeur de liquide par goutte à goutte est installé au sommet de ce montage expérimental. A l'aide du dispositif précité, on laisse percoler au travers de la mousse supportant les films 8 litres d'eau déminéralisée, durant une période de 48 heures, à raison de 40 gouttes par minute. Cette quantité d'eau représente, par rapport à la surface expérimentale, la moyenne approchée des hauteurs d'eau reçues en 5 ans au

d) - Étude de l'activité insecticide sur Réticulitermes santonensis de particules de polyéthylène traitées avec différents biocides, en mélange avec un substrat

Les particules de dimensions suivantes : diamètre 2,5 mm, longueur 4 mm, obtenues selon la méthode précédemment citée, sont incorporées à du sable de Fontainebleau humidifié (1 volume d'eau pour 4 volumes de sable) à raison de 1 volume de granulés pour 9 volumes de sable. Ce mélange correctement homogénéisé, vient remplir entièrement un tube en verre de 50 mm de diamètre et 350 mm de hauteur. A la base de ce tube, vient s'adapter un autre cylindre de verre de 50 mm de diamètre et de 50 mm de hauteur, garni de sable humide qui contient un bloc de bois appât. On aura soin d'intercaler entre les deux tubes une membrane de papier filtre qui tiendra lieu de témoin de passage. Le montage est coiffé d'un autre tube de verre (50 mm de diamètre et 50 mm de hauteur), contenant une rondelle de mousse polyuréthanne épousant le diamètre intérieur du tube, et de 25 mm d'épaisseur. Cette rondelle est traversée par 2 trous de diamètre 3 mm et une parcelle de bois provenant de l'élevage de Réticulitermes santonensis est fichée au centre de sa face supérieure. Une population de 150 ouvriers Réticulitermes santonensis en bon état sanitaire est introduite par l'ouverture supérieure du dispositif expérimental que l'on coiffe en final d'un couvercle découpé dans de la mousse polyuréthanne.

La profondeur de pénétration dans le substrat traité et le taux de mortalité sont contrôlés à la fin de la période expérimentale de 4 semaines. Pour chaque biocide testé, et à chacune des concentrations de biocide dans la matière plastique, 4 dispositifs expérimentaux ont été mis en œuvre. Chacun des essais a été répété deux fois. Lors de chaque répétition, 4

La dose d'imprégnation pourra être aussi faible que environ 0,5 %, la limite supérieure étant dictée par des considérations économiques et de normalisation, par exemple environ 2 %, de préférence 1 %.

Il doit d'ailleurs être entendu que la description qui précède n'a été donnée qu'à titre d'exemple et qu'elle ne limite nullement le domaine de l'invention dont on ne sortirait pas en remplaçant les détails d'exécution décrits par tous autres équivalents.

En particulier, on pourra faire remonter le film sur une dizaine de centimètres le long du mur, au-dessus du sol. On pourra également développer des barrières plus ou moins verticales à une certaine distance tout autour de l'endroit à protéger, sur une profondeur appropriée connue de l'homme du métier. On opérera par pose verticale d'un film selon l'invention dans une tranchée protégeant à toute distance souhaitée tout le pourtour de la zone considérée, et en remblayant avec éventuellement adjonction de granulés selon l'invention aux endroits particulièrement menacés. On pourra aussi seulement creuser une tranchée et remblayer avec adjonction des granulés selon l'invention. On peut ainsi mieux protéger les nouveaux travaux et/ou effectuer des traitements de « renouvellement » en combinaison avec, ou en remplacement, de la méthode ancienne.

6. - Procédé selon l'une quelconque des revendications 1 à 5 **caractérisé** en ce que l'on utilise un film de polyéthylène chargé de environ 0,5 à 2 %, de préférence environ 1 % de perméthrine.

7. - Procédé selon l'une quelconque des revendications 1 à 6 **caractérisé** en ce que, de plus, on remblaie le site de la construction par un mélange de substrat de remblai normal (11) et de granulés ou matières de géométries analogues de matière plastique imprégnée d'insecticide (10), au niveau des zones où le film est, soit volontairement perforé, soit risque d'être perforé ou interrompu accidentellement.

8. - Procédé selon la revendication 7, **caractérisé** en ce que lesdits granulés ou matières ont la même composition que le film lui-même, et éventuellement proviennent de fragments, déchets ou résidus ou rebuts de sa fabrication.

9. - Films insecticides pour application selon le procédé selon l'une quelconque des revendications 1 à 8, tels que définis dans ces revendications 1 à 8.

10. - Granulés et matières analogues pour mélange au remblai selon le procédé selon l'une quelconque des revendications 7 ou 8, tels que définis dans ces revendications 7 ou 8.

11. - Application des procédés, films et granulés selon l'une quelconque des revendications 1 à 10 aux constructions nouvelles et/ou aux traitements de renouvellement curatifs et/ou préventifs et/ou à la protection de zones par barrières verticales profondes.

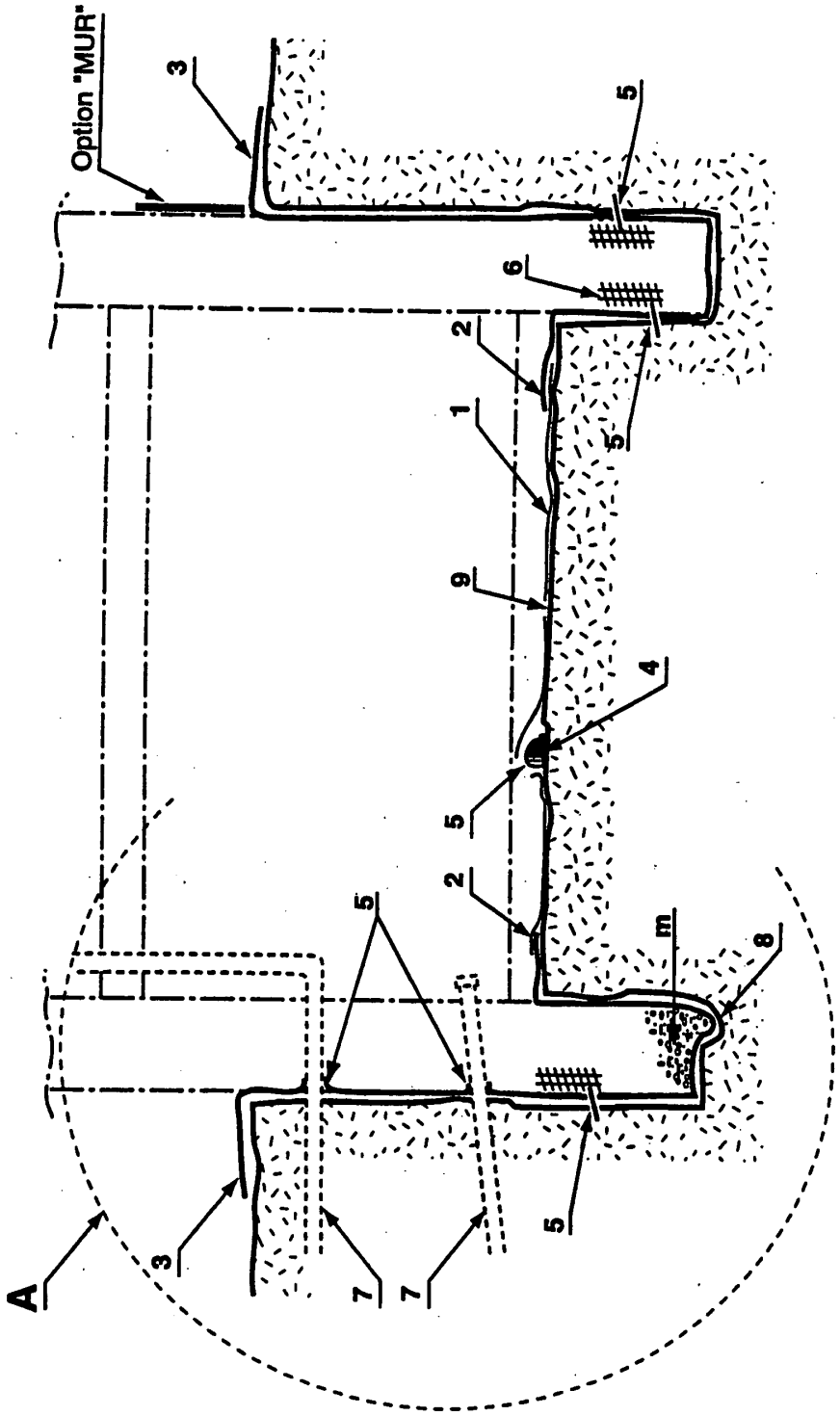

FIGURE 2

VERIFIED TRANSLATION OF PCT 13886/95

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in the name of
CECIL S.A.

I, MELVYN WILLIAM DUGARD, M.I.T.I., A.I.L., Translator to the firm of Boult Wade Tennant, European Patent Attorneys, of 27, Furnival Street, London, England, do hereby certify that I am conversant with the English and French languages and am a competent translator thereof, and I verify that the attached translation corresponds to the text of the French specification of PCT Patent Application No. PCT/FR94/01541 as published.

Signed this 22nd day of July 1996

(Signature) M.W. Dugard

MELVYN WILLIAM DUGARD

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(57) Abstract

The invention concerns the application of a plastic film impregnated with an anti-termite agent around the sides and base of an excavation site. Said plastic film is combined with anti-termite granules in backfill in the region of pipe and duct passages. This film has a preventative function and does not require repeat treatments. It can be further used in the form of curative or preventative renewed treatment in old constructions

"METHOD AND MATERIALS FOR THE PROTECTION OF BUILDINGS AGAINST TERMITES"

The present invention relates to the preventative protection of buildings against termites.

At present, the protection of buildings against the penetration of harmful isoptera (termites) is generally effected by pouring, spraying or injecting insecticide products in doses which should prove to be sufficient to ensure protection for a number of years. A ban on the use of certain insecticides, which are effective but which cause substantial toxic and ecotoxic pollution, has resulted in the use of substances which are less dangerous but which are less stable chemically, so that it is necessary for the operations to be repeated at more frequent intervals, which gives rise to difficult problems owing to the dispersal of undesirable materials into the environment.

Moreover, these preventative and curative renewal treatments are, by definition, carried out after the construction of the building and, therefore, it is necessary to drill through the walls, floors, etc, which involves heavy and expensive work, causing inconvenience and the complete effectiveness of which is difficult to assure, since it is not always possible to drill the recommended number of holes. Furthermore, after construction, certain locations prove to be inaccessible to preventative and/or curative treatments of this type.

Finally, in an endeavour to increase the effectiveness of the preventative and/or curative treatments, there may be a considerable temptation to overdose the product, particularly around inaccessible locations, with the obvious dangers of pollution, which were precisely those which it was desired to avoid.

If it is recalled that it only requires one or more unprotected ways of penetration, which are very few

in number, to allow the termites to invade a building and cause the well-known damage thereto, it is possible to judge the gravity of the problem and the necessarily serious deficiencies of the preventative and/or curative renewal treatments, even if they have been properly carried out, since the "chemical barrier" is rarely continuous.

The present invention aims to obviate these drawbacks and relates to a method for the protection of buildings against termites, which method is put into effect during the construction of the buildings themselves, and which is characterised in that said protection is permanent and complete, even though it makes use of new generation termicides, this combination of properties hitherto being considered to be impossible.

In fact, it was known how to obtain complete and permanent protection prior to construction but only by pouring, etc., substances which are now prohibited.

It was also known to use less powerful substances, however, this depended on the use of preventative and/or curative renewal treatments (therefore, the method was not "permanent") and gave rise to the very considerable danger of allowing the presence of unprotected penetration paths (therefore, the method was not "complete").

However, the invention proposes a method and means combining four essential properties, the simultaneous combination of which was previously considered to be impossible:

1. Application prior to construction.
2. Use of new generation substances.
3. "Complete" treatment (continuous "chemical barrier", therefore no unprotected paths).
4. "Permanent" treatment (no need to resort to preventative retreatments or curative treatments in the event of failure).

Various plastic materials are also known for the controlled release of active ingredients. In particular,

the document FR-A-2 491 037 (ROUSSEL-UCLAF) discloses packing and coating materials with insecticide properties and comprising a film of plastic material (polyethylene, for example) which is impregnated throughout by means of a compound of the pyrethrin type.

The document JP 59-62503 discloses a kraft paper sheet impregnated with termicide and coated on one of its two sides with a plastic film. The product is supposed to diffuse through the polyethylene. It is a strong composite product intended for "under floor" use, i.e. in precise areas. Moreover, it involves old technology (1982), i.e. at a time when powerful termicides were authorised, even at high doses, parameters which are now strictly controlled.

USP 5,224,288 is also known, which is very significant in that it illustrates the state of the art immediately prior (1993) to the present invention. This American patent describes a fibrous mat impregnated with termicide. The fibres are mandatory, since only this arrangement ensures both a large surface area and adequate mechanical strength. Moreover, this document states that, necessarily, the mesh size of the fibrous structure has to be smaller than the insect, otherwise the insect can penetrate the structure.

Therefore, immediately prior to the present invention, the person skilled in the art understood:

- that it was necessary to provide a large surface area to diffuse a sufficient amount of product;
- that, despite this precaution, the insect could reach the fibrous mat and penetrate it, which shows that the chemical barrier was considered to be inadequate; perhaps, because of the "immediate" loss of product "by capillary attraction" into the ground.

Therefore, the person skilled in the art was not directed towards a solution of the film or fibrous mat type but was diverted away therefrom.

However, the invention relates to the application

of an insecticidal plastic film for the protection of buildings against termites, using a method which comprises laying the film over the entire building surface exposed by the digging operations necessary for the erection of the building, including the foundation trenches, etc., this point being important, as will be explained below.

To judge the significance and originality of the invention it is necessary to view the situation in the context of the problem posed and its technical environment.

For example, within the framework of the aforementioned patent FR'037, it involved protecting the substances with an insecticide film. However, on the one hand, the application of the film could be mechanised and it was carried out in accordance with certain procedures and in the factory: therefore, correct application of the film was ensured and its insecticide action guaranteed. If a tear or fault was noticed, the packing could simply be diverted and repaired. Even if an undetected fault remained, it would result in only slight damage.

However, in the civil engineering sector it was unreasonable to expect building workers to apply a thin film very carefully to the ground and around the foundations, to check with even greater care that no reinforcing rods, pebbles, debris, etc., will perforate the film (it should be remembered that termite colonies are in a state of perpetual expansion and that their instinct urges them to radiate about the termitarium - they find the damp and "quiet" earth beneath a building to be particularly suitable - and to spread, preferentially, along pipe systems, etc., and that, therefore, a single unprotected passage is sufficient for an invasion of termites), to dispose carefully and with caution of the fillers and building materials, cement, etc., so that these materials do not in turn perforate the film, namely to ask workmen to give up their practices associated with their technical sector and which are thus quite

understandable.

This was all the more unlikely since passages have to be provided, particularly in the foundations, for the advance of pipe systems, cables, etc., of all types, which makes it necessary for the film to be perforated, cut, etc.

Finally, a film with controlled release of termicidal product could, by definition, only release small doses of product per unit of time, as confirmed by the aforementioned USP'288; therefore, at the very best one could expect a more or less repellent effect at the locations where the film has not been torn, perforated or badly positioned, or opened to pipe systems, etc., an effect which would thus quite simply direct the insects towards the locations at which there is a tear, perforation, etc., where they could penetrate the building without causing damage and, obviously, invade it.

Therefore, it was obvious to the person skilled in the art that a plastic film with controlled release could not provide any guarantee of success, taking into account the trade under consideration and its unavoidable constraints.

Accordingly, the trade has adapted to the drawbacks of curative treatments.

The Applicants, to their credit, have overcome the prejudices associated with the depositing of a film and have decided on a research programme, despite the investment involved and the almost certain risk of failure, that is according to the reasoning of professionals.

It is also to credit of the Applicants and their invention that they persevered after encountering the expected difficulties and, nevertheless, developed all the components of an original test programme and, finally, demonstrated that, contrary to all expectations, the termicidal film provides the desired solution.

The accompanying drawings, illustrated by way of

example, will enable the invention, its features and the advantages which it can provide to be understood more clearly:

Figure 1 of the drawings is a vertical schematic section showing the theoretical application of the system for protection against termites according to the invention.

Figure 2 is comparable to Figure 1, except that it represents the actual application with serious incidents (tears, perforations, sheets laid with insufficient covering, etc.) which the person skilled in the art expected and which are in fact encountered.

Figure 3 represents an enlargement of a Zone A in Figure 2, and also the detailed means of the invention and its effects.

Figure 1 shows that, in an excavation formed after the digging work intended for the construction of the foundations (in chain lines) for a building, there has been spread out a series of sheets 1 of a film of plastic material impregnated with an insecticide product. These sheets 1 overlap one another (2) and they cover all the building surface, even extending substantially at ground level (3).

Figure 2 shows what happens in practice. Some of the sheets are poorly positioned for covering purposes (no or insufficient overlapping), as shown at (9). Pebbles or debris perforate the film. During the laying operation grids, reinforcing rods (6) and projections perforate the film. During the casting of the foundations, the film is deflected or stretched under the pressure of the cast material m and the danger of piercing occurs at those locations where there is a sharp edge, as shown at (4), under the film or at the numerous locations where there is a void under the film (it is obvious that the film does not closely conform to well-prepared ground; it can only be placed on ground irregularly littered with debris and, accidentally, with metal parts, etc.), as shown at (8). In

any case, the film has to be deliberately perforated to allow the passage of pipe systems or sheaths (7).

Each of these incidents creates a slit, opening or tear (5), many of which are unpredictable and cannot even be recognised, and only one of these slits, openings or tears is required to allow an invasion by termites.

Therefore, the problem posed is to attain the "zero fault", in this case the "zero penetration point". Figure 2 shows the gamble which this objective represents with the simple aim of laying a film.

The invention lies in the manner in which it tackles the problem. There are two categories of tearing risks.

a) - deliberate openings, such as those provided for the sheaths (7). These at least have the merit of being known. Therefore, one could think of effecting local treatment of the tear by sealing, etc. but in this field there would not be a total guarantee;

b) - totally unpredictable accidental tears. No preventative measures are possible against the latter.

It was also known that, by definition, the film could not release a substantial amount of product when the release is gradual, and that the film and its vicinity are subjected to washing effects by water and moisture and other product losses, as confirmed by the above-mentioned USP'288. Finally, termicides are degraded at the very alkaline pH values of the building materials.

Therefore, tears could not be prevented and the product released could be relied upon to form a sufficiently concentrated and extensive barrier to the neutralise the tear zones.

Nevertheless, the Applicants decided to verify this latter point and found that, contrary to all expectations, the film treated against termites (described below) was able, despite the gradual release of small doses, to create 1) a repellent effect and 2) a contact and "shock" effect.

The unexpected contact effect observed is essential. According to the tests carried out, an insect arriving in the immediate vicinity of the film is clearly disturbed after only 10 s exposure : difficulty in moving, disturbed orientation and similarly disturbed behaviour. This is wholly in contrast with the teaching of USP'288.

Therefore, without being able to escape, the insect reaches the equally very short period of time, at the end of which the lethal shock effect occurs.

In the extremely general case in which the insect is thus faced with a sound film, it is either repelled or subjected to the contact effect then to the shock effect. In the first case, it may seek and find a less protected opening. However, in this case, the Applicants have established that, contrary to expectations and knowledge, the insect is then subjected very rapidly (in only a few seconds!) to the contact effect which leads to the shock effect.

Therefore, the Applicants have established that even with not very careful installation practice, a termicidal film provides complete and permanent protection as a result of a double barrier illustrated in Figure 3 having a repellent effect (protection of openings) and a contact and shock effect (destruction).

The plastic material film which forms the sheets 1 can be obtained by the extrusion of polymers, particularly polyolefins, such as polyethylene or polypropylene or polyvinyl chloride and analogous (co)polymers, the thickness of which is between 50 µm and 300 µm. The insecticide is incorporated in the plastic material during the production of the compound, the proportion being a function of the effectiveness of the active ingredient used. The production of the film is carried out starting from this compound by hot extrusion-blowing or by extrusion, it being possible for either one of these extrusion methods to be followed, optionally, by hot-pressing and analogous processes known to the person

skilled in the art.

The insecticides which can be used are variable and are those known to the person skilled in the art. In particular, it is possible to use:

- either insecticides of the chemical family of the pyrethrins of the type described in above-mentioned document ROUSSEL-UCLAF (permethrin or phenoxy-3 benzyl (±) Cis trans (dichloro 2,2 vinyl) - 3 dimethyl-2,2 cyclopropane carboxylate with the molecular formula $C_{21}H_{20}Cl_2O_3$;
- or insecticides of the chemical family of the carbamates, such as Benfuracarbe (dihydro-2,3 dimethyl-2,2 benzofuranyl - 7 N - (N - ethoxycarbonyl)-2 ethyl-N isopropylaminosulphenyl)-N-methylcarbonate), with the molecular formula $C_{20}H_{20}N_2O_5S$;
- or organohalogens;
- or organophosphorous compounds;
- and known analogous products which need not be specified here.

The person skilled in the art will naturally be able to choose the most suitable and these examples are not restrictive. It would also be possible to use mixtures.

As is evident, openings necessarily have to be made in the film formed by the sheets 1, in particular for the passage of supply lines (water, gas, electricity) and outlet ducts. To obviate the slightest risk and to be absolutely sure of restoring the continuous nature of the protective barrier formed by the plastic film, a preferred embodiment of the invention lies in treating these openings during the filling operation (of the foundation, for example) by incorporating into the substrate (11), which forms the covering filler, granules (10) of insecticidal plastic material, advantageously at a rate of (about) 1 volume of granules per 9 volumes of substrate. The openings have to be filled with this mixture over a thickness and a depth of at least about 10 cm.

The granules used have preferably (depending on the nature of the ground, on the degree of washing with water, and on the estimation of the dose released, factors which the person skilled in the art could readily determine by routine tests from reading the following examples and tables) dimensions of the order of about 2 to 3 mm in diameter over a length of about 2-5 mm. Their chemical composition is similar to that of the film which forms the sheets 1. They may also be waste from the production of the film or rejected pieces of film, etc., and the like but this is not preferred (problems in respect of homogeneity of the doses released). As a precaution, one could proceed in the same way at the locations where the film is most exposed to probable tearing, as at (8). Preference is given to granules and all geometries have roughness or sharp edges, such as cut rods.

The great advantage of this variant is two-fold: it is easily carried out by the building workers, with no particular care needed; and the preferred use of waste, etc., from the film.

The masonry work can be resumed after these *simple* operations.

The secondary advantages achieved by this method for protection against termites in relation to conventional systems for pouring insecticide compounds in the liquid phase are also obvious.

- The active insecticide materials are protected from external attack by the plastic material of the film in which they are incorporated, said film allowing slow diffusion.

- The quantities of insecticide products are very clearly lower than those used according to a conventional process. The following tables and examples allow a simple comparison to be made.

- The risk of pollution to the ground and phreatic strata is greatly reduced since the insecticides held

captive within the plastic material are released only at a very low rate.

- The danger of contamination of the environment in the event of an accident occurring during the conveyance of the insecticide film is absolutely zero, whereas there is a high danger associated with the conveyance of liquid insecticides to be poured.

The protective barrier formed by the sheets 1 is especially visible during complementary digging work, so that it can be easily restored.

- This protective barrier can be easily removed in the event of demolition.

The following tests have been carried out by the Applicants:

a) - *Study of the insecticide activity on Reticulitermes santonensis of a polyethylene film treated with permethrin.*

Several polyethylene films are used having a thickness of 200 µm and containing different amounts of permethrin. These films were obtained using the method described above. A control film of polyethylene is also used which does not contain any biocidal active material.

The film to be tested is retained between 2 glass tubes which are open at the end, have an inner diameter of 50 mm and a height of 50 mm (S = 19.63 cm2). A support of neutral material of 1 mm thickness is deposited on the surface of the film and supports a disc of filter paper which is moistened to saturation. The filter paper, which is thus not in contact with the treated film, serves after daily remoistening as nourishment and as water reserve for the insects required for the experiment. After the introduction into each of the devices of 25 Reticulitermes santonensis workers in a good state of health, a cover of polyurethane foam is placed on each of the devices. The mortality rate is verified after 6 hours, 12 hours, 24 hours and then each day for 7 days, starting from the date when the insects were introduced into the experimental

devices. For each concentration of biocide in the plastic material there were carried out two repeats of the test which, itself, uses four experimental devices of 25 termites per concentration.

The following table summarises the experimental results obtained.

Plastic material: polyethylene
Active biocidal material : permethrin

Dose of biocide in (m/m) in the support	% of mortality						
	6 H	12 H	24 H	2 D	3 D	4 D	7 D
0.005	0	0	4	36	52	64	84
0.05	0	0	8	60	88	96	100
0.25	20	36	84	100			
0.50	52	88	100				
1.00	100						
Controls	0	0	0	0	0	2	8

CONCLUSIONS:

With a dose of 1 % of permethrin incorporated into the polyethylene the material exhibits satisfactory anti-termite characteristics.

b) Study of the insecticide activity on Reticulitermes santonensis of a polyethylene film treated with Benfuracarbe.

The test methodology is the same as that indicated in the foregoing; the films are obtained in accordance with the process described above.

The following table summarises the experimental results obtained.

Dose of biocide in % (m/m) in the support	% of mortality						
	6 H	12 H	24 H	2 D	3 D	4 D	7 D
0.005	0	0	0	4	12	20	65
0.05	50	64	100				
0.25	100						
0.50	100						
1.00	100						
Controls	0	0	0	0	0	2	8

CONCLUSIONS:

With a dose of 1 % of benfuracarbe incorporated into the polyethylene the material exhibits satisfactory anti-termite characteristics.

b) Study of the influence of dilution by infiltrating water on the insecticide activity of the plastic material used by the method forming the subject-matter of the invention.

Samples of films treated as described above are held captive in the polyurethane foam. They are introduced vertically into the glass tubes of a diameter of 50 mm and a height of 50 mm, at a rate of 4 samples per tube, treated with the same doses and with the same active principle. A device for dispensing liquid drop by drop is installed at the top of this experimental device. By means of the aforementioned device 8 litres of demineralised water are allowed to percolate through the foam supporting the films over a period of 48 hours and a rate of 40 drops per minute. This quantity of water represents, in relation to the experimental surface area, the approximate average of rain received in 5 years per square metre in various West European towns commonly recognised as being subject to termite invasion.

Following this dilution test, the films are removed from the devices and dried without being wiped. The insecticide activity is then verified according to the method described in paragraph a) above.

The following table summarises the experimental results obtained.

Plastic material: polyethylene

Nature of biocide	Dose of biocide in % (m/m) in the support	% of mortality						
		6 H	12 H	24 H	2 D	3 D	4 D	7 D
Permethrin	0.05	0	0	0	8	8	11	32
	0.25	0	0	13	37	69	100	
	0.50	30	56	72	90	100		
	1.00	100						
Benfuracarbe	0.05	0	0	0	36	49	78	94
	0.25	0	0	2	46	71	99	100
	0.50	16	24	30	68	100		
	1.00	31	44	52	100			
Treated controls		0	1	1	1	1	1	4

CONCLUSIONS:

With a dose of 1 % of permethrin or benfuracarbe incorporated into the polyethylene the material exhibits satisfactory anti-termite characteristics after undergoing the dilution test.

d) Study of the insecticide activity on Reticulitermes santonensis of particles of polyethylene treated with different biocides, mixed with a substrate.

Particles of the following dimensions : diameter 2.5 mm, length 4 mm, obtained according to the above-described method, are incorporated into moistened Fontainebleau sand (1 volume of water per 4 volumes of sand) at a rate of 1 volume of granules per 9 volumes of sand. This properly homogenised mixture entirely fills a glass tube which is 50 mm in diameter and 350 mm in height. Fitted to the base of this tube is another glass cylinder, 50 mm in diameter and 50 mm in height, which is filled with moist sand containing a block of wood as bait. Care is taken to interpose between the two tubes a membrane of filter paper which will serve as a control passage. The device is covered by another glass tube (50 mm in diameter and 50 mm in height), containing a disc of polyurethane foam conforming to the inner diameter of the tube, and 25 mm in thickness. This disc is traversed by two holes 3 mm in diameter and a piece of wood, which originates from the breeding of Reticulitermes santonensis, is inserted into the centre of its upper surface. A population of Reticulitermes santonensis workers in a good state of health is introduced through the upper opening of the experimental device which is finally covered with a lid cut into the polyurethane foam.

The depth of penetration into the treated substrate and the mortality rate are checked at the end of the 4-week test period. 4 experimental devices were used for each biocide tested and at each of the concentrations of biocide in the plastic material. Each of the tests was repeated twice. During each repetition 4 devices devoid of any biocide were used as controls.

The following table summarises the experimental results obtained.

Nature of biocide	Dose of biocide in % (m/m) in the granules	Depth of penetration in the substrate in mm	Survival rate of termites
Permethrin	0.25	150	18.00 %
	1.00	10	8.00 %
Benfuracarbe	0.25	199	11.4 %
	1.00	16	8.4 %
Treated controls		400	80.8 %

CONCLUSIONS:

With a dose of 1 % of permethrin or benfuracarbe incorporated into the polyethylene particles, the material, which is mixed with sand in the proportions defined above, imparts satisfactory anti-termite characteristics to the substrate.

These tests demonstrate the activity of the film laden with 1 %, as well as the granules (10) which may be used mixed with the filler (11), and also the satisfactory resistance to dilution.

It was noted that the repellent effect was effective practically whatever the dose applied.

The person skilled in the art will readily know how to determine the doses required for the "contact" and "shock" effects described according to the invention by routine tests based on the above examples and simple soil samples, etc.

The impregnation dose could be as low as about 0.5 %, the upper limit being dictated by economic and standardisation criteria, for example about 2 %, preferably 1 %.

Moreover, it should be understood that the foregoing description has only been made by way of example and that it in no way restricts the scope of the

invention, and replacing the described details of the embodiments with any others which are equivalent will not represent any departure therefrom.

In particular, the film could be mounted a dozen centimetres along a wall, above the ground. It would also be possible to develop more or less vertical barriers arranged at a certain distance all around the location to be protected, over a suitable depth known by the person skilled in the art. A film according to the invention is disposed vertically in a trench protecting at any distance desired the entire periphery of the zone in question, the locations particularly under threat being filled optionally with the addition of granules according to the invention. It would also be possible merely to dig a trench and fill it with the addition of granules according to the invention. New works can thus be better protected and/or "renewing" treatments can be carried out in combination with or in replacement of the old method.

CLAIMS

1. A method for the protection of buildings against termites, characterised in that it comprises laying, prior to the erection of the building, over the entire building surface exposed by digging operations, including foundations, a film of plastic material which is impregnated throughout with an insecticide compound, the entire arrangement allowing the insecticide to diffuse slowly.

2. A method according to claim 1, characterised in that the film is formed by a series of overlapping (2) sheets (1) which project substantially at ground level (3).

3. A method according to claim 1 or 2, characterised in that the plastics material is chosen from the polyolefins, such as polyethylene or polypropylene, polyvinyl chloride and analogous (co)polymers.

4. A method according to any one of claims 1 to 3, characterised in that the insecticide is a termicide chosen from the pyrethrins, such as permethrin, and the carbamates, such as benfuracarbe, the organohalogens or the organophosphorous compounds and the like.

5. A method according to any one of claims 1 to 4, characterised in that the plastic material is polyethylene-based and the insecticide is permethrin.

6. A method according to any one of claims 1 to 5, characterised in that a polyethylene film is used laden with about 0.5 to 2 %, preferably about 1 %, of permethrin.

7. A method according to any one of claims 1 to 6, characterised in that, additionally, the building site is filled with a mixture of a substrate of normal filler (11)

and granules (10) or materials of similar geometry of plastic material impregnated with insecticide, at the level of the zones where the film is either deliberately perforated or risks being accidentally perforated or interrupted.

8. A method according to claim 7, characterised in that said granules or materials have the same composition as the film itself, and optionally originate from fragments, waste, residues or rejects formed in the manufacture thereof.

9. Insecticide films for application in accordance with the method according to any of claims 1 to 8, as defined in these claims 1 to 8.

10. Granules and analogous materials to be mixed with the filler in accordance with the method according to either claim 7 or 8, as defined in claim 7 or 8.

11. Application of the methods, films and granules according to any one of claims 1 to 10 to new buildings and/or to curative and/or preventative renewal treatments, and/or to the protection of zones by deep vertical barriers.